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ABSTRACT

This catalog contains descriptions of the science education programs and materials in the National Diffusion Network (NDN). These programs and materials are available to school systems or other educational institutions for implementation in their classrooms. Some programs may be able to offer consultant services and limited assistance with the training and materials associated with installing one of these programs in schools. Information about the NDN is provided. Programs listed include: (1) "Conservation for Children"; (2) "Foundational Approaches in Science Teaching (FAST)"; (3) "Geology Is"; (4) "Hands-On Elementary Science"; (5) "Informal Science Study (ISS)"; (6) "Life Lab Science Program"; (7) "Marine Science Project: FOR SEA"; (8) "The Mechanical Universe"; (9) "Physics Resources and Instructional Strategies for Motivating Students (PRISMS)"; (10) "Physics-Teach to Learn Program"; (11) "Sci-Math"; (12) "Starwalk"; (13) "Stones and Bones: A Laboratory Approach to the Study of Biology, Modern Science, and Anthropology"; and (14) "Wildlife Inquiry through Zoo Education (WIZE)." A listing of state facilitators and a facilitator for private schools is also listed. (CW)

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Science Education Programs That Work

A Collection of Proven Exemplary Educational Programs
and Practices
in the National Diffusion Network

Compiled by
Mary G. Lewis

Recognition Division, Programs for the Improvement of Practice
of the

Office of Educational Research and Improvement
U.S. Department of Education, 555 New Jersey Avenue, NW.
Washington, D.C. 20208-1525

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Contents

Page No.

Introduction v

So You Want to Know More about the NDN 1

Descriptions of Science Programs

Conservation for Children 3

*Foundational Approaches in Science Teaching (FAST) 4

*Geology Is 5

*Hands-On Elementary Science 6

Informal Science Study (ISS) 7

*Life Lab Science Program 8

*Marine Science Project: FOR SEA 9

*The Mechanical Universe 10

*Physics Resources and Instructional Strategies for Motivating Students (PRISMS) 11

*Physics—Teach to Learn Program 12

*Sci-Math 13

Starwalk 14

Stones and Bones: A Laboratory Approach to the Study of Biology, Modern Science, and Anthropology 15

*Wildlife Inquiry Through Zoo Education (WIZE) 16

State Facilitators 17

Private School Facilitator 22

*Receiving dissemination grant funds from the U.S. Department of Education.

Introduction

This catalog contains descriptions of the science education programs in the National Diffusion Network. These programs are available to school systems or other educational institutions for implementation in their classrooms. While all of the programs have been validated as effective by the Department of Education's Program Effectiveness Panel (formerly the Joint Dissemination Review Panel), those marked with an asterisk in the Table of Contents are currently receiving funds for dissemination from the National Diffusion Network. The funded programs may be able to offer to interested schools consultant services and limited assistance with the training and materials associated with installing one of these programs in their classrooms. Unfunded Panel-approved programs are able to offer services through cost/service agreements negotiated with potential adopters.

For further information on the National Diffusion Network or on these programs in science education, please contact your State Facilitator or Private School Facilitator (see listing, pages 16–20) or the National Diffusion Network Program, Office of Educational Research and Improvement, U.S. Department of Education, 555 New Jersey Avenue, NW., Washington, D.C. 20208-1525, or by telephone at (202) 357-6134.

national diffusion network

SO . . .
You Want to Know More about the NDN

What is the National Diffusion Network?

The National Diffusion Network (NDN) is a federally funded system that makes exemplary educational programs available for adoption by schools, colleges and other institutions.

It does so by providing dissemination funds to exemplary programs, called Developer Demonstrator projects, for two purposes: (1) to make public and nonpublic schools, colleges and other institutions aware of what they offer, and (2) to provide training, materials and followup assistance to schools and others that want to adopt them.

NDN also provides funds to State Facilitators, whose job it is to serve as matchmakers between NDN programs and schools and organizations that could benefit from adopting the programs.

What makes the NDN Developer Demonstrator projects different from commercial products?

Several important things. NDN Developer Demonstrator project staff do not just hand a program to a school and expect the school to figure out how to use it. Instead, NDN program directors help local schools implement their programs to suit each school's unique needs. To do that, the director of the program provides training, lasting from one day to a week or more, to staff members in the adopting school. The director also provides followup assistance in the form of additional training, visits, telephone consultation and newsletters. Sometimes, a program director or a State Facilitator arranges for all adopters of a particular program in a region or state to form a network so they can share successful approaches and solve common problems. All NDN services are provided at little or no cost to adopters.

How does NDN assure that a program is effective and worthy of replication in other schools?

Before a program can become eligible for funding as a part of the NDN, it must be approved by the Department of Education. A program requesting a review must provide evaluation data that prove that the program is effective in the school in which it was developed or field tested, and that it could be used successfully in other schools. As of December, 1987, approximately 450 programs had been approved and 82 of them were receiving Federal dissemination funds to help other schools adopt them.

What kinds of programs are available for adoption through the NDN?

NDN programs can meet the needs of students of every age — preschool through adult — and the needs of teachers, administrators and other school personnel. Subject areas represented among the NDN programs include mathematics, science and reading. There are also programs in writing, technology, the humanities and programs for gifted and talented students.

Some programs are designed to improve preservice and inservice teacher training. Other fields represented include special education, career and vocational education, adult literacy, early childhood education, health and physical education. Some programs are directed toward processes to improve school administration and management and thereby improve instruction.

Is it possible to see a Developer Demonstrator program in Action?

Yes. Each Developer Demonstrator program receiving federal dissemination funds maintains a demonstration classroom or school where visitors are welcome. These programs are located across the United States. In addition, many of the programs have demonstration sites in states other than the one in which they were developed. NDN State Facilitators can arrange for visits to a demonstration school, or to an adoption site.

How does a school adopt an NDN program?

The first step is to contact one of the NDN State Facilitators. Their job is to help schools and other organizations learn about and adopt NDN programs. Often, for examples, they hold "awareness conferences" featuring one or more NDN programs and invite educators to attend. They also work with educators in identifying the needs in a particular school and in determining which NDN program offers a solution. When a school decides to adopt an NDN program, the facilitator arranges for the program's developer to provide training to staff in the adopting school. In addition, if a school requires financial assistance to make an adoption, the facilitator usually knows about funding sources and how to apply for a grant under various Federal, State or local programs or from private foundations or industry. Some facilitators sponsor meetings for administrators on how to apply for financial assistance.

What if the program a school wants to adopt is located in another state?

That's no problem; the NDN was developed so that educators would have access to exemplary programs, whether these programs are located in the same state or not. NDN brings the program to the school or district that wants it.

How much does it cost to adopt an NDN program?

The cost varies. NDN's aim is to provide adoption assistance at minimal cost. State Facilitators are supported by NDN grants, so there is no cost for their services, and there is little or no cost for training. An adopter usually pays for any required curriculum materials and for release time for teachers to attend training. Some schools help meet adoption costs with a grant from local or state funding sources or with funds from other sources including the private sector.

What is the responsibility of a school in making an adoption?

Each Developer Demonstrator program has basic requirements to be met by adopters. Adopting schools, for example, are usually required to implement certain basic features of the program, such as regular monitoring of students' academic progress or the use of certain activities. Some programs may require the adopting schools to compile pretest and posttest scores or other appropriate measures of effectiveness and growth in order that the adopted program's benefits can be accurately evaluated. Each adopter agrees to an adoption plan which outlines roles and responsibilities of the parties concerned.

Can NDN really help schools?

Many teachers, administrators and other educators think so. In 1986–87 alone, NDN programs were installed in approximately 20,000 schools. An estimated 50,000 teachers and other school personnel received training in the use of NDN programs and approximately 2,000,000 students were served by these adoptions. Several evaluations of the NDN show that it is meeting its goal of helping schools improve education through the dissemination of effective programs.

Where can you get more information about NDN programs?

Contact your NDN State Facilitator, Private School Facilitator, or U.S. Department of Education, Recognition Division, 555 New Jersey Avenue, NW., Washington, D.C. 20208–1525; phone (202) 357–6134.

CONSERVATION FOR CHILDREN. A practical, economical program to increase conservation awareness, understanding, and action of elementary school children through a variety of basic skill activities.

Audience Approved by JDRP for children in grades 1-6.

Description Through a variety of basic skill activities intended for use in the classroom, Conservation for Children teaches about the interdependence of plants and animals, requirements of life, energy sources and use, pollution problems, recycling, and other conservation concepts based on scientific principles. The grade level conservation guides provide instructional materials which combine basic skill practice in the areas of language arts, math, social studies and science with a conservation concept. Program materials are used to supplement or replace presently used skill materials, so that no additional preparation time or equipment is needed. Teachers can use the materials as a primary resource for teaching basic skills, as supplementary materials to a core program, as enrichment activities, skill review, or as independent units of study. No change in staffing, physical setting, equipment, or instructional methodology is required. Criterion-referenced tests allow teachers to determine which materials are appropriate for individual students or groups. Special education teachers have found the materials valuable for use with their students due to the high interest level of the worksheets and the choice of ability levels and basic skill concepts.

Evaluation data confirms that students using the materials for a minimum of 30 minutes per week master 80% of the learning objectives. In addition, 75% of the parents of 2,000 students in the evaluation study responded in writing that they had observed their children implementing conservation practices at home which they had never seen before the children used the program materials.

Requirements The program may be used in any type of facility or setting and does not rely on any particular methodology or teaching style. The program is designed for use in the classroom and does not require any materials or equipment that are not normally found in any school. The curriculum guides may be reproduced in whole or in part with the permission of the authors. Inservice training as to implementation and material usage is minimal, usually two hours. The program requires no staffing changes as the classroom teacher continues to provide instruction.

Conservation for Children materials include six grade-level curriculum guides and one all-levels guide (activities, resources). After the initial purchase of the guides, $25 per grade level or $165 for the complete program, there are no ongoing costs for personnel, materials, or inservice training. A per pupil cost for installation is only $.70. There are no recurring costs.

Services Awareness materials are available at no cost. Visitors are welcome at the project site any time by appointment. Project staff are available to attend out-of-state awareness meetings (costs for travel expenses to be negotiated).

Contact ***Marilyn Bodourian, Project Director, Conservation for Children, John Muir Elementary School, 6560 Hanover Drive, San Jose, CA 95129. (408) 725-8376.***

Developmental Funding: ESEA, Title IV-C

FOUNDATIONAL APPROACHES IN SCIENCE TEACHING (FAST). A course in the concepts and methods of the physical, biological, and earth sciences and their relation to the environment.

Audience Approved by JDRP for students in grade 7. This program has also been used with students in grades 6 and 8.

Description This curriculum is a full year course giving students a sense of the operations of the modern scientific community by involving them in typical science activities. FAST is laboratory and field-oriented and designed for use with students who represent the full range of abilities and interests found in the typical middle/junior high school classroom. Instructional strategies are structurally sequenced to address differences in learning styles and to develop thinking skills. Students study three strands concurrently: physical science, ecology and relational study.

The physical science strand introduces such concepts as mass, volume, density, buoyancy, physical and chemical properties of matter, pressure, vacuum, heat, temperature and energy; the ecology strand such concepts as ecology, plant and animal growth and development, weather and climate, field mapping and population sampling; the relational study strand such concepts as resource management, technology, environmental use, energy use and conservation.

Student and teacher materials guide student investigations. The Student Record Book enables students to record a concise log of individual and class activities. A classroom library of Student Reference Booklets (which describe use of instruments, suggest experimental designs, outline experimental techniques, and provide necessary supplemental readings) helps students to practice the skill of using outside references to supplement information available from the investigations and Student Record Book. The Teacher's Guide presents the logic connecting topics and sequences. Keyed to the investigations in the Student Record Book, the Teacher's Guide includes teaching suggestions, advice on classroom procedures, and detailed discussion of the conceptual and practical development of the students' investigations. Other materials for teachers include the Instructional Guide and Evaluation Guide.

Requirements Adopting teachers are required to take 10 days of training (provided free with sufficient book purchases). Adopting schools are assumed to have basic science equipment and supplies including 6-10 centigram balances. An equipment kit is required. Recommended: a local project coordinator to monitor implementation activities, conduct bimonthly meetings with adopting teachers, and provide help to teachers as needed. Additional training is available for local coordinators and teacher trainers.

Services Awareness materials are available at no cost. Examination copies of student and teacher materials are available at cost; a videotape describing the program is available on loan (specify Beta or VHS). Visitors are welcome at project site and at selected demonstration sites by appointment. Some demonstration sites are available in other states. Project staff and/or certified representatives are available to attend awareness meetings on negotiated cost basis. Teacher training is conducted each summer at project site or can be provided for adopters at adopter site.

Contact ***Donald B. Young, Co-Director, Curriculum Research and Development Group, University of Hawaii, 1776 University Ave., Rm UHS 2-202, Honolulu, HI 96822 (808) 948-7863.***

Developmental Funding: University of Hawaii

GEOLOGY IS. An introductory geoscience course.

Audience Approved by JDRP for all students, grades 9-12.

Description Designed to become part of the secondary school curriculum, Geology Is provides geoscience learning opportunities not presently available in the science curriculum. A broad range of materials and media-delivery instruments allow for varied teaching and learning techniques. The technical aspects of course content and the social implications in the wise use of earth resources combine in an effective interdisciplinary approach. Awareness and understanding of geoscience processes make students more responsible consumers of earth materials and protectors of the environment.

The five distinct but related units of Geology Is are Introduction, Earth Materials, Observing the Earth, Internal Processes, and External Processes. These are subdivided into a total of 20 chapters. Although it is a two-semester course, parts can be taught as a semester offering. Each unit contains text material, lab exercises and activities, and objective and subjective tests. Slide-tapes, films, videotapes, and guest speaker presentations are offered, and students are encouraged to evaluate these. Small groups and individuals investigate topical areas for student-led class discussions. Off- and on-campus field experiences and resource personnel add another dimension to the text. Teachers are provided with a guide and an activities handbook as a supplement to the student textbook.

Through study in this elective option, students can become more responsible consumers of earth resources and make informed decisions for the future regarding energy, geologic hazards, and land use.

Requirements The adopting district will need to provide an instructor with some basic coursework in the geosciences. Other than that, a typical science classroom and supplies are the only requirements for adoption.

The major cost to the district will be for the purchase of the Geology Is textbook and activity sheets. In addition, some supplies for the activities may have to be purchased if the district does not have an existing geoscience class.

Services Awareness materials are available at no cost. A slide-tape presentation is available if district will pay postage. Visitors are welcome at project site anytime by appointment. Project staff are available to attend out-of-state awareness conferences (cost to be negotiated). Training is conducted either at the project site or at the adopter site (costs to be negotiated). Implementation and follow-up services are available to adopters (costs to be negotiated).

Contact ***Rion D. Turley, O'Fallon Township High School, 600 South Smiley, O'Fallon, IL 62269. (618) 632-3507.***

Developmental Funding: ESEA, Title IV-C

HANDS-ON ELEMENTARY SCIENCE. An instructional program intended to provide elementary students with hands-on instruction emphasizing the processes of science.

Audience Approved by JDRP for students, grades 1-5.

Description The Hands-On Elementary Science provides elementary students with instruction that emphasizes the development of science processes as an approach to problem solving. In fostering positive teacher attitudes toward teaching science, it increased both the amount of science taught and the proportion of instruction dedicated to the processes of science. The curriculum employs a set of higher order of processes at each grade level consisting of three basic units. The units consist of lessons concerning a unifying topic. The topic is based upon the skills identified for that grade level. First grade students work primarily on observation in the three units of seeds, patterns and "magnetism." Second grade emphasizes classification skills through the study of insects, sink or float, and measurement. In the third grade, experimentation skills are developed by units on flight, measuring and plants. Fourth grade focuses on analysis in units on bio-communities, electricity and chemistry. The fifth grade curriculum emphasizes application and consists of units on earth science, soil analysis and small animals. Since this is not a text program, all lessons are based upon hands-on activities supported and defined by curriculum guides at each grade level. They provide a sequence of basic lessons and incorporate all necessary materials to support the program lessons. A unique feature of the program is an optional package of materials students may request to work on over the summer.

Requirements The Hands-On Elementary Science program is transportable to other sites where a commitment exists for hands-on science instruction. Adoption of this program requires at least a half year planning and preparation followed by a staff development program. Teacher preparation consists of two days training prior to the implementation of the program followed by at least two followup workshops to resolve problems of implementation. Materials required include both a curriculum guide and a kit of materials of the appropriate grade level for each teacher and copies of the voluntary summer program for dissemination to interested students.

The cost of the program in the installation year is approximately $27 per student, assuming 25 students per class in a school of 800 students and with the training involving 20 teachers at a grade level. Subsequent year costs to maintain the program through the replacement of consumable supplies equal $1.50 per student. Teacher guides are available for $10 each and kits are available from a national vendor at costs ranging from $400 to $600 depending upon the grade level.

Services Awareness materials are available at no cost. Visitors are welcome by appointment at project site and additional sites in home state. Project staff are available to attend out-of-state awareness meetings (costs to be negotiated). Training is available at project site and also at adopter site (costs to be negotiated). Implementation and follow-up services are available to adopters (costs to be negotiated).

Contact ***Dr. Dean A. Wood, Hands-On Elementary Science, Education Department, Hood College, Frederick, Maryland 21701, (301) 663-3131 (Ext. 205 or 350).***

Developmental Funding: Federal, State and Local

INFORMAL SCIENCE STUDY (ISS)

Audience Approved by JDRP for all students in grades 5-12.

Description ISS supplementary presents physical science mini-units based upon student recall and utilization of popular amusement park rides, sports, and playground experiences in concept acquisition. Experiences are selected for their student appeal and their ability to provide concrete examples of otherwise abstract concepts. Topics covered include motion, acceleration, relativity, forces, gravity, time, graphing, conservation of energy, and frames of reference.

Each of the mini-units is designed around student dialogue, providing an introduction and review/application of physical science and mathematics in low-key, predominantly nontechnical, language. Physical science terms are introduced only after instruction as needed. In addition, several of the units provide laboratory experiences using toys (race cars, model rockets etc.) and playground equipment.

With instructional periods from 1-3 weeks, students significantly increase knowledge and comprehension of science concepts, analytic recall of science experiences, and demonstrate significantly increased applications of science concepts to unique situations. Instruments by which students were measured were constructed and validated as part of the curriculum design and evaluation procedures.

Requirements Mini-units may be adopted individually or as a group. Teachers may be trained in 4 hours. Costs including training, materials, and equipment are approximately $2.00 per student (n=500), with a recurring cost of $.60 per student.

Services Awareness materials are available at no cost. Visitors are welcome to visit the project site by appointment. Project staff are available for awareness meetings (cost to be negotiated).

Contact ***Dr. Howard Jones, Informal Science Study, University of Houston, Room 450 Farish Hall, Houston, TX 77004, (713) 749-1692 or 1685.***

Developmental Funding: National Science Foundation

LIFE LAB SCIENCE PROGRAM. An applied science program emphasizing a hands-on "living laboratory" approach to elementary science education.

Audience Approved by JDRP for elementary students, grades 2-6.

Description The Life Lab Science program strives to ensure students' future interests and success in science by improving student attitudes toward the study of science, and increasing students' level of knowledge and skill acquisition in science. The instructional approach is a combination of indoor and outdoor hands-on science activities with the key component being the garden lab (e.g. indoor grow box, greenhouse, planter boxes, vegetable beds, etc.). Students and teachers collaborate to transform their school grounds and/or classrooms into thriving garden laboratories for the study of scientific processes. In this setting students conduct experiments using the scientific method. They observe, collect and analyze data, establish worm colonies, raise vegetables, herbs and flowers, and have responsibility for maintaining their living laboratory. A structured course of study is followed in science, nutrition and gardening. Instructional time varies from two to four hours per week. Teachers are responsible for all classroom instruction and use *The Growing Classroom*, a three volume curriculum guide, for the bulk of their science lessons.

Requirements The critical learner setting is the "living laboratory" whether an indoor grow box, containers adjacent to the classroom, a greenhouse or a three acre school farm. As such, all elements of the program are transportable. The primary curriculum guide is *The Growing Classroom*, which contains three volumes—Science, Nutrition and Gardening and is accompanied by a scope and sequence outline. No textbooks are required; however, gardening tools are needed. Learning materials are predominantly household items. Prior to implementation, the program has a two-day workshop at the school site or at project site that prepares teachers for using the program, teaching techniques and the "living laboratory" approach. Following the initial training, staff development and program implementation become the responsibility of a Lead Teacher in each school. Advance training is available for Lead Teachers and technical assistance will continue to be provided throughout the installation year. Adopters of the Life Lab Science Program typically generate a great deal of community support and resources. Cultivating the community is an important requirement of a successful adoption.

The adopter is responsible for travel and per diem costs. Trainer fees are to be negotiated. Implementation costs vary by site and the extent of "living laboratory" development. A set of *The Growing Classroom* curriculum must be purchased for each implementing classroom teacher at $40 per set.

Services Awareness materials are avilable at no cost. Visitors are welcome by appointment at project site and additional sites in home state and out-of-state. Project staff are available to attend out-of-state awareness meetings (costs to be negotiated). Training is conducted either at project site or adopter site (costs to be negotiated). Follow-up technical assistance is also available.

Contact ***Lisa Glick/Gary Appel, Life Lab Science Program, 809 Bay Avenue, Suite H, Capitola, CA 95010, (408) 476-7140, Ext. 223.***

Developmental Funding: ESEA, Title IV-C; Packard Foundation;
California State Department of Education; National Science Foundation

MARINE SCIENCE PROJECT: FOR SEA. Comprehensive, activity-oriented marine science curriculum which teaches basic science skills and knowledge on or away from the coast.

Audience Approved by JDRP for all students, grades 2, 4, 6, 7-8 and 9-12.

Description By the year 2000, three out of four Americans will live within an hour's drive of the sea or Great Lakes coasts. The impact on these coastal waters will be severe. The nationally validated curriculum materials of Marine Science Project: FOR SEA are designed to equip students with information necessary to protect and maintain the world of water.

FOR SEA provides comprehensive, activity-oriented, marine education curriculum to be used in addition to or in lieu of an existing science program. Curriculum guides for each of the grade levels contain teacher background for each activity, student activity and text pages, answer keys for student activities, a listing of vocabulary words for each unit, and a selected bibliography of children's literature of the sea and information books of the sea.

The Marine Science Project: FOR SEA is documented effective in teaching basic science skills and knowledge as measured by the CTB McGraw-Hill CTBS Science Test and by project-developed tests. The magic draw of water provides incentive to teach and learn science.

Requirements The Marine Science Project: FOR SEA is designed to be implemented in classrooms at a room, grade, school, or district-wide level. Eight hours of inservice training provide implementing classroom teachers with an overview of the project, text implementation procedures, and activities designed to familiarize them with the materials. A copy of the appropriate grade level curriculum guide must be purchased for each implementing classroom teacher at $35 per guide. Student text materials in the guide are designed to be reproduced by the adopting sites. Hands-on materials are generally found in the school setting or are readily available at local grocery or variety stores. The startup costs vary by site.

Services Awareness brochures and samplers of curriculum are available. Project staff are available to attend out-of-state awareness sessions, with negotiable costsharing. Inservice training is provided to adopter site, again with costsharing negotiable. Followup services are provided by the project in appropriate cost-effective ways, including telephone, mail cassette tape, and visits.

Contact ***Laurie Dumdie, Demonstrator/Trainer, Marine Science Center, 17771 Fjord Drive N.E., Poulsbo, WA 98370. (206) 779-5549.***

Developmental Funding: ESEA, Title IV-C

THE MECHANICAL UNIVERSE

High School Adaptation

AUDIENCE **APPROVED BY PEP for all high school physics teachers and students.**

DESCRIPTION **The Mechanical Universe High School Adaptation presents a fresh and intriguing approach to understanding physics, with the goal of improving competency of teachers and motivating students toward mastering a conceptual understanding of physics.**

The materials have been designed to: assist students in achieving higher levels of understanding; increase students' conceptual understanding of physics; bring a more interesting, more integrated approach to physics through use of audiovisual references; present topics, illustrations, and applications not usually available in other materials; and assist teachers in expanding their backgrounds in physics and instructional procedures effective for these materials.

The audiovisual materials developed for The Mechanical Universe High School Adaptation show close-ups of complicated experiments, use extensive computer animation that makes abstract concepts more understandable, and reenact historical moments to provide a philosophical fabric for the development of ideas in physics. This material consists of 24 modules each with a 15-minute videotape and print materials for the teacher and student.

The program does not replace an entire textbook-based physics course, for it has no text, no lab component, and limited activities to assign students. Nor is it simply supplemental. For many or most physics topics typically presented in high school, these materials can replace traditional material being used. The 24 topics available cover all but a very few topics contained in a traditional physics course, with some that are new to the average course, such as "Navigating in Space."

REQUIREMENTS It is strongly recommended that in-service be provided prior to the use of these materials. Ideally, before the school year begins, teachers should participate in a workshop of at least two weeks. A video cassette recorder and television are required for classroom implementation.

SERVICES Learning materials include 24 modules, each with a 15-minute videotape and print materials for the teacher and students. Awareness and training workshops available with costs to be negotiated.

COSTS Purchase cost for the 24 modules is $450, including unlimited duplication rights at one site.

CONTACT Dr. Richard P. Olenick, Department of Physics, University of Dallas, 1845 East Northgate Drive, Irving, Texas 75062-4799. (214) 721-5313.

DEVELOPMENTAL FUNDING National Science Foundation

PEP No. 88-18

PHYSICS RESOURCES AND INSTRUCTIONAL STRATEGIES FOR MOTIVATING STUDENTS (PRISMS). A physics program that relates physics to the lives of high school students and stimulates students to develop reasoning and science problem-solving skills.

Audience Approved by JDRP for students in grades 10-12 with background in beginning algebra, especially for those students who need additional motivation to learn the concepts and practical applications of physics.

Description PRISMS blends exploratory activities, concept development, and application activities into a learning cycle. The concepts addressed in the PRISMS teacher resource guide are those typically included in most high school physics courses including kinematics, dynamics, work and energy, internal energy and heat, wave phenomena, electricity and magnetism, and atomic and nuclear physics. High interest activities involving cars, bicycles, balloon rockets, dart guns, sailboats, etc., are utilized to teach the major concepts in physics. Exploration activities encourage students to observe relationships, identify variables, and develop tentative explanations of phenomena. Concepts are introduced through the experiences in this exploration phase. The student tests the generalization through observations in the application stage.

For each of 125 activities there are student sheets and teacher notes. The teacher notes include teaching strategies, sample observations and calculations, a summary of the concept or outcome of the activity, and time required to conduct the activity. In most cases, there are multiple activities to support the learning cycle. The activities in the guide are an appropriate replacement of traditional laboratory experiments rather than supplementary materials.

Requirements To implement the program, the normal science laboratory facilities should be available. Desirable, but not required, would be one to four computers to use for data acquisition; specific software is recommended for the project. The physics teacher should understand the teaching strategies and be familiar with many of the activities before implementing the program. Inservice training for one to three weeks is highly desirable. PRISMS materials include the teacher resource guide, two video tapes and a test bank of questions for evaluating student learning.

Costs for training of one teacher, purchase of two computers, software and interfacing, and other materials and supplies is approximately $3,300. If computers are already available or will not be purchased, the cost would be reduced by $1,600. Based on 24 students per section for 5 sections of physics, the cost per student in the installation year is approximately $27.25 per student with purchase of computers and $7.92 without. The materials and supplies budget assumes a normally stocked high school physics laboratory. Items such as Hot Wheels, windup cars, dart guns, etc. are figured in the cost of supplies; however, some schools have students bring these items from home.

Services Awareness materials are available at no cost. Training is conducted during the summer at the development site, the University of Northern Iowa. In addition, staff are available to conduct workshops at other locations with costs to be negotiated.

Contact ***Dr. Roy D. Unruh, PRISMS, Physics Department, University of Northern Iowa, Cedar Falls, Iowa 50614, (319) 273-2380.***

Developmental Funding: Iowa Department of Education
U.S. Department of Education - Secretary's Discretionary Fund

PHYSICS—TEACH TO LEARN. A physics instructional program using teacher-controlled computer simulations and supporting curriculum materials.

Audience Approved by JDRP for 12th-grade physics students.

Description The Physics—Teach to Learn program provides both teachers and students with instructional materials and processes that facilitate the exploration and illustration of selected physical events that have been found to be most frequently misunderstood by students and most difficult for the teacher to illustrate in the classroom, and then tests the students' understanding and ability to make application of the physics concepts underlying those events.

The program's 15 instructional modules, with teacher-controlled computer simulations and supporting curriculum materials (developed by a committee of Los Angeles Unified School District master physics teachers with university support), were designed to provide students with fundamental qualitative understanding of physical events in selected topic areas. The computer simulations require the learner to make a judgment about a physical event. This judgment, based upon learner experience, and/or observation, often reveals misconceptions based upon defective logic. After the initial judgment (pretest), the teacher then utilizes the computer simulation(s) to lead the student through the steps of exploration, development, and application. By using this step-by-step method, the teacher is best able to guide the correction of student misconceptions about the physical events under consideration. After this process has been completed, the student takes a formal paper/pencil posttest. Each topic is accompanied by extensive written curriculum material designed to enhance the teacher's ability to present the key concepts.

Requirements The Physics—Teach to Learn project-developed materials were designed to be adaptable to any course approach and to be compatible with any text format. They are packaged to facilitate dissemination and implementation at other sites. The program's computer disks are designed for use with either an Apple IIc or IIe computer, a graphics printer, and a monitor. For classroom utilization, a 19-inch or larger television is recommended for display. No prior computer experience is necessary to effectively use the project's computer software or curriculum materials. Experienced physics teachers can be trained in the philosophy, content, and use of the modules in 4 hours. New and "crossover" teachers will need two days of training.

Curriculum materials, including the computer disks, are available for a cost of $300 per set. Project trainers will conduct training sessions at no cost to the adopting agencies, other than those attendant to travel, when training occurs during the "on-time" school year of the trainers. A negotiable honorarium of $150-$250 per day will be requested when the time or service of a trainer is contracted over a weekend or during the "off-time" portion of the trainer's school year. Districts may also have to consider the costs attendant to releasing their teachers to participate in the training sessions. Finally, if the adopting site does not have the equipment required to implement the program, the additional cost will be approximately $1,550. Once the curriculum materials have been purchased and initial training has occurred, the program can be operated with no additional cost factors.

Services Awareness materials are available at no cost. Visitors are welcome by appointment at the project's demonstration sites. Project staff are available to attend out-of-state awareness meetings. Training can be conducted either at the project site or at specified adopter sites. A Physics—Teach to Learn quarterly newsletter will be published to provide opportunities for two-way communication between the parent project and the adopting schools. Comments regarding the classroom use of the project's instructional materials will be solicited from schools implementing the program. Comments received will be included in the newsletter along with updates of the instructional modules and information about the progress of the national dissemination effort.

Contacts ***Charles Schleiden, Project Disseminator, Bell High School, 4328 Bell Avenue, Bell, CA 90201, (213) 773-2408. Mary Ann Sesma, Principal, Bell High School and Project Director, (213) 560-1800. Leni Posner, Specialist, Grants Assistant Unit, Los Angeles Unified School District, 450 North Grand Avenue, Room A-307, Los Angeles, CA 90012, (213) 625-6596.***

Developmental Funding: ECIA, Chapter 2

SCI-MATH. A curriculum module that bridges the abstract operations taught in mathematics and their application in the introductory sciences and in everyday activities.

Audience Approved by JDRP for students who are average to above-average achievers in grades 7-10 or low achievers including educationally disadvantaged at a slower rate in grades 7-12.

Description Sci-math is a modular curriculum that teaches the skills and concepts needed to apply proportions to problem-solving in the introductory sciences and in the everyday world. It consists of two modules, each requiring approximately 1/4 of a school year for the average student. Module One is a prealgebra module which deals with the arithmetic and logic of proportions. Module Two examines how algebraic equations express proportions, and studies the graphical interpretation of proportions.

Many students have a great deal of difficulty with the mathematical aspects of the sciences, and fail to understand, appreciate, and like the sciences. Sci-math teaches students to apply the operations taught in mathematics to problems encountered in everyday life and in science. The approach is based on a modification of the "unit-pricing" concept, a method now used heavily in the sciences which requires the use of measurement labels like miles, grams, and seconds, in all the calculations. Mathematics in everyday living involves and applies this same concept—in consumer purchasing, business, crafts, and industry. This approach to proportions enables even Piagetian preformal students to understand and apply proportions to problem-solving.

There are 23 hands-on activities in the course available for the classroom. All problems and activities deal with variables familiar to students such as those found in the home, play, school, and business, etc. The materials used are readily available and inexpensive, such as rulers, string, pennies, spoons, jars and masking tape. By carrying these activities out with familiar variables, students can learn the mathematics of relationships so they can later apply these to the sciences. They also learn about measurement, inexact numbers, and estimation. A teachers' manual provides solutions to all problems, as well as data and answers to questions for the activities.

The curriculum may be used as a mathematics course for average students in the 8th grade or as a physical science course for 8th or 9th grades, or as an elective course in grades 9-12. Slow learners may use the modules at a slower rate doing more of the problems and activities, in grades 9-12. High achievers may start at 7th grade or earlier. At all grades, Sci-Math may be elected in part or as a whole, and may be interfaced into an existing course or used separately. The program was developed by Dr. Madeline P. Goodstein.

Requirements Sci-Math can be used in any classroom. Student modules and teacher guides are available at less than $6 per copy. Materials can be reused for several years. Material costs for activities and experiments are minimal.

Services Awareness materials are available at no cost. Project personnel are available for on-site awareness and/or training workshops. Costs for these services as well as evaluation and followup are to be negotiated with the sponsoring organization.

Contact ***James P. McAuliffe, Sci-Math Director, Education & Technology Foundation, 4655 25th Street, San Francisco, CA 94114, (415) 824-5911.***

Developmental Funding: National Science Foundation

STARWALK. A comprehensive earth/space science program for elementary students.

Audience Approved by JDRP for grades 3 & 5. The program has also been used in other grades.

Description Project STARWALK provides differentiated instruction in earth/space concepts which accommodate various developmental levels. Students receive a series of lessons structured around three visits to a planetarium to prepare them for their activities at the planetarium and to consolidate and further the learning after the visit. Planetarium handbooks and teaching packets provide the instructional materials for these lessons. Classroom teachers participate in the activities along with their students. Students in grade 3 are introduced to the Milky Way and the concept of time. Students in grade 5 study the planets and the solar system configurations, and seasons around the world. Inservice orientation and technical assistance are available as well as a management system for scheduling of students, equipment or service purchase, and dissemination and evaluation.

Requirements The availability of a planetarium model in a laboratory or classroom is a component of this program. The program should be implemented on a district-wide basis on the elementary level because lessons on each grade level are sequential. A science teacher or other staff member can be trained to carry out the program. There is a minimal amount of instructional material needed.

Evaluation kits are $25 each. Two are available, one for third grade and one for fifth grade. They include 50 student scan sheets, student response summaries for pre- and posttests, classroom means for pre- and posttests, and statistical report of student growth for pre- and posttests. Cost of the instructional, management, and training materials packet is $25 per packet. Teacher guides from the packet may be duplicated for participating teachers at an adoption site. Per pupil cost per year is dependent upon costs for student transportation, planetarium utilization fees, supplies, and indirect costs.

Services Awareness materials are available at no cost. Developer is available to attend out-of-state awareness meetings (costs to be negotiated). Visitors are welcome at project site during school year by appointment. Training is conducted at adopter or project site (training no cost at project site, adopter pays own expenses; training no cost at adopter site, adopter pays developer's expense). Training is conducted at adopter site during school year by appointment. Implementation/followup services are available to adopters (costs to be negotiated).

Contact ***Mr. Bob Riddle, Project STARWALK, Lakeview Museum Planetarium, 1125 W. Lake Avenue, Peoria, Illinois 61614. (309) 686-NOVA.***

Developmental Funding: ESEA, Title IV-C; State and Local

STONES AND BONES: A LABORATORY APPROACH TO THE STUDY OF BIOLOGY, MODERN SCIENCE, AND ANTHROPOLOGY. An innovative program designed to enrich and meet the present modern or life science, biology, and physical anthropology courses.

Audience Approved by JDRP for science students of all ability levels. The program has been successfully implemented in grades 7-12.

Description The program meets the needs of all ability levels. The format is interdisciplinary in design and emphasizes active student participation through laboratory explorations. Modern (general) or life science and biology instructional units supplement, enrich, and extend current science curricula.

Three instructional pathways emphasize the study of humankind: *Modern (General) Science Pathway:* Designed to motivate non-college-oriented students. Each of the 20 laboratory explorations offers the general science student "hands-on" opportunities to investigate topics such as geologic time, measuring radioactivity, mapping, behavior of primates, and replica casts of fossil hominids. During this four to six weeks unit, students will also have an opportunity to simulate archaeological excavation.

Biology Pathway: A 4- to 6-week overview of physical anthropology. The unit provides students with "hands-on," in-depth experiences as a supplement to physical anthropology in biology textbooks. A series of 11 investigative explorations focuses on topics including primate behavior and distribution, interpreting archaeological records, primate locomotion and morphology, and replica casts of fossil hominids. This approach reinforces and extends many basic concepts taught in the study of biology.

Semester Course Pathway: This pathway in physical anthropology provides students the opportunity to study the story of humankind in depth. Laboratory investigations pursue such topics as phylogeny through time, continental drift, locomotion and behavior of primates, classification and morphology, as well as 14 fossil replica casts of Australopithecus, *Homo erectus*, Neanderthal, and Cro-Magnon.

Instructional materials for all three pathways are highly self-directive, requiring minimal teacher training. In addition to printed materials, cast replicas of fossil casts and instructional materials used in the explorations have been validated to be scientifically accurate by the L.S.B. Leakey Foundation, Los Angeles County Museum of Natural History, and by world-recognized anthropologists from various major universities.

Requirements Stones and Bones can be implemented in various ways. The selection of the pathway is determined by school and student needs. All three pathways require no special facilities or equipment. Existing classrooms and readily available items from any classroom such as rulers, scissors, and paste will be adequate. Teachers with little to no anthropology background will need no more than one day of training for initiating each of the three pathways successfully. Teachers' Guides for the three pathways are available to effectively implement the program.

Based on the recommended basic materials needed for implementation, the start-up cost will be approximately $471 for modern (general) science unit, $895 for biology unit, and $1300 for semester course. An alternative is to implement the program with fossil cast photo reprints in actual size in lieu of the fossil replica cast; the cost will then be approximately $55 for each of the instructional pathways. Any number of classes can share the materials if classes are scheduled at different periods or days. There is no additional cost in subsequent years of operation.

Services Awareness materials are available at no cost. Visitors are welcome at project's demonstration school site by appointment. Training workshops are conducted at project sites and/or adopter sites with costs to be shared. Project staff is available to attend awareness meetings out of state with costs to be negotiated.

Contact ***Dr. Sid Sitkoff, Director, Los Angeles Unified School District, Office of Instruction, 450 N. Grand Ave., Los Angeles, CA 90012. (213) 625-6419. Milton Anisman, Disseminator, Physical Anthropology Center, 6625 Balboa Blvd., Van Nuys, CA 91406. (818) 997-2389.***

Developmental Funding: ESEA, Title IV-C

WILDLIFE INQUIRY THROUGH ZOO EDUCATION (WIZE) — Module II, *Survival Strategies.* A life sciences program which improves understanding of concepts related to population ecology, wildlife conservation, and species survival.

Audience Approved by JDRP for all students, grades 7-9.

Description Combining classroom study with the unique scientific resources available at zoos, *Survival Strategies* explores issues related to wildlife survival in the 21st century.

Using a nontraditional, multidisciplinary approach, the program improves understanding of concepts related to population ecology, wildlife conservation, and species survival. In small study groups and in highly motivating hands-on activities that encourage decision-making, *Survival Strategies* develops an understanding that animals are members of populations that interact with one another and that ecological processes affecting animals also affect humans. Involving an average of 15 weeks of instruction (for classes with at least four science periods a week; 20 weeks for those with fewer science periods per week), the program includes three zoo visits (or one combined visit if access to a zoo is difficult.) Using motivational activities, materials such as photo cards and worksheets, discussions, zoo visits, and considerable homework, students are exposed to the scientific method and develop problem-solving skills, working towards solutions which cause the least disruption to the environment.

Along with Module I of WIZE (*Diversity of Lifestyles,* which explores habitats and survival techniques), *Survival Strategies* educates young people to approach difficult problems analytically and make decisions based on informed perspectives rooted in a firm understanding of complex scientific concepts. The two modules form a continuum in the study of wildlife ecology; however, each can serve on its own merits as an independent curriculum or as a supplement to an existing life sciences program.

Requirements No special facilities are required within an adopting school. Access to a zoo is recommended but the program has been used by some teachers without such access. Although the detailed Teachers' Manual enables instructors to conduct the program successfully without special training, such training is useful and is encouraged for optimal implementation. Curriculum/learning materials include the following:

8 sets of 24 Discovery Cards
34 student resource books: *Survival Strategies*
22 photo cards
40 student worksheets to accompany lessons
120-page Teachers' Manual for 23 lessons
2 cassettes and a 96-frame filmstrip
Posterity, a wildlife management game

Implementation of the WIZE *Survival Strategies* program requires purchase of one kit for each classroom at a cost of approximately $250. Expenses of trainers are negotiable. Other costs are for transportation and entry fees into local zoos.

Services Awareness materials are available at no cost. Project staff are available for awareness presentations and training with all costs negotiable.

Contact ***Annette Berkovits, Curator of Education and Director of Project WIZE, Bronx Zoo, New York Zoological Society, 185th Street and Southern Boulevard, Bronx, New York 10460, (212) 220-5135 or 6855.***

Developmental Funding: National Science Foundation

STATE FACILITATORS
(Updated September 1989)

ALABAMA

Ms. Maureen Cassidy
Alabama Facilitator Project
Division of Professional Services
Room 866 - State Office Building
Montgomery, Alabama 36130
(205) 261-5065

ALASKA

Ms. Sandra Berry
State Facilitator
Alaska Department of Education
Pouch F - State Office of Education
Juneau, Alaska 99811
(907) 465-2841

ARIZONA

Dr. L. Leon Webb
Arizona State Facilitator
Educational Diffusion Systems, Inc.
161 East First Street
Mesa, Arizona 85201
(602) 969-4880

ARKANSAS

Ms. Susan Jurgensmeier
State Facilitator
Arkansas Department of Education
Arch Ford Education Building
State Capitol Mall
Little Rock, Arkansas 72201
(501) 682-4568

CALIFORNIA

Ms. Jane E. Zinner, Director
Ms. Joyce Lazzeri, State Facilitator
Assoc. of CA School Administrators
1575 Old Bayshore Highway
Burlingame, California 94010
(415) 692-2956

COLORADO

Mr. Charles D. Beck, Jr.
The Education Diffusion Group
3800 York Street - Unit B
Denver, Colorado 80205
(303) 837-1000 X2136

CONNECTICUT

Ms. Sally Harris
Connecticut Facilitator Project
Area Cooperative Ed. Services
205 Skiff Street
Hamden, Connecticut 06517
(203) 248-9119

DELAWARE

Ms. Carole D. White
State Facilitator Project
Department of Public Instruction
John G. Townsend Building
Dover, Delaware 19901
(302) 736-4583

DISTRICT OF COLUMBIA

Ms. Susan Williams
District Facilitator Project
Eaton School
34th and Lowell Streets, N.W.
Washington, D.C. 20008
(202) 282-0056

FLORIDA

Ms. Sue Carpenter
State Facilitator
Florida Department of Education
Division of Public Schools
Knott Building
Tallahassee, Florida 32301
(904) 487-3496 or 487-1078

GEORGIA

Ms. Frances Hensley
Georgia Facilitator Center
607 Aderhold Hall, UGA
Athens, Georgia 30602
(404) 542-3332 or 542-3810

HAWAII

Dr. Elaine Takenaka
Hawaii Educational Dissemination
Diffusion System (HEDDS)
Office of Instructional Services
595 Pepeekeo Street, Building H.
Honolulu, Hawaii 96825
(808) 396-6356

IDAHO

Mr. Ted L. Lindley
State Facilitator
Idaho State Department of Education
Len B. Jordan Office Building
Boise, Idaho 83720
(208) 334-2186

ILLINOIS

Dr. Shirley Menendez
Project Director
Statewide Facilitator Project
1105 East Fifth Street
Metropolis, Illinois 62960
(618) 524-2664

INDIANA

Dr. Lynwood Erb
Project Director
Indiana Facilitator Center
Logansport Community School Corp.
Logansport, Indiana 46947
(219) 722-1754

IOWA

Ms. Michelle Soria-Dunn
State Facilitator
Department of Public Instruction
Grimes State Office Building
Des Moines, Iowa 50319
(515) 281-3111

KANSAS

Mr. James H. Connett
Kansas State Facilitator Project
Director KEDDS/LINK
3030 Osage Street
Wichita, Kansas 67217
(316) 833-3960

KENTUCKY

Ms. Barbie Haynes
Kentucky State Facilitator
Kentucky Department of Education
Capitol Plaza Tower Office Bldg.
Frankfort, Kentucky 40601
(502) 564-6720

LOUISIANA

Mr. Charles Jarreau or
Ms. Brenda Argo
Facilitator Project Director
State Department of Education
ESEA Title IV Bureau Office
P. O. Box 44064
Baton Rouge, Louisiana 70804
(504) 342-3424

MAINE

Ms. Elaine Roberts
Center for Educational Services
P. O. Box 620
Auburn, Maine 04210
(207) 783-0833

MARYLAND

Dr. Raymond H. Hartjen
Maryland Facilitator Project
Educational Alternatives, Inc.
Mail to: P.O. Box 265
Port Tobacco, MD 20677
Ship to: 115 La Grange Avenue
La Plata, Maryland 20646
(301) 934-2992 (D.C. line 870-3399)

MASSACHUSETTS

Ms. Denise Blumenthal
Ms. Nancy Love
THE NETWORK
290 South Main Street
Andover, Massachusetts 01810
(508) 470-1080

MICHIGAN

Ms. Carol Wolenberg
Michigan State Facilitator
Michigan Department of Education
Box 30008
Lansing, Michigan 48909
(517) 373-1806

MINNESOTA

Ms. Diane Lassman and
Ms. Barbara Knapp
Minnesota State Facilitator Office
The EXCHANGE at CAREI
116 U Press Building
2037 University Avenue S.E.
University of Minnesota
Minneapolis, Minnesota 55414-3097
(612) 624-0584

MISSISSIPPI

Bobby Stacy
Mississippi Facilitator Project
State Department of Education
P.O. Box 771
Jackson, Mississippi 39205
(601) 359-3498

MISSOURI

Ms. Jolene Schulz
Project Director
Missouri Education Center
1206 East Walnut
Columbia, Missouri 65201
(314) 875-8782 or 800-392-0549

MONTANA

Mr. Ron Lukenbill
State Facilitator Project
Office of Public Instruction
State Capitol
Helena, Montana 59601
(406) 444-2080

NEBRASKA

Dr. Elizabeth Alfred
Facilitator Project Director
Nebraska Department of Education
301 Centennial Mall
P. O. Box 94987
Lincoln, Nebraska 68509
(402) 471-3440

NEVADA

Ms. Doris Betts
State Facilitator
Nevada Department of Education
400 W. King Street
Capitol Complex
Carson City, Nevada 89710
(702) 885-3136

NEW HAMPSHIRE

Mr. Jared Shady
NH Facilitator Center
80 South Main Street
Concord, New Hampshire 03301
(603) 224-9461

NEW JERSEY

Ms. Katherine Wallin or
Ms. Elizabeth Ann Pagen
Education Info. & Resource Center
N. J. State Facilitator Project
700 Hollydell Court
Sewell, New Jersey 08080
(609) 582-7000

NEW MEXICO

Dr. Amy L. Atkins
New Mexico State Facilitator
Dept. of Educational Foundations
U of NM - College of Education
Onate Hall, Room 223
Albuquerque, New Mexico 87131
(505) 277-5204

NEW YORK

Ms. Laurie Rowe
State Facilitator
N. Y. Education Department
Room 860 EBA
Albany, New York 12234
(518) 474-1280

NORTH CAROLINA

Ms. Alean Miller
Project Director
N.C. Education Department
N.C. Dept. of Public Instruction
116 West Edenton Street
Raleigh, North Carolina 27603-1712
(919) 733-7037

NORTH DAKOTA

Mr. Charles DeRemer
State Facilitator
Department of Public Instruction
State Capitol
Bismarck, North Dakota 58505
(701) 224-2514

OHIO

Mr. C. William Phillips
Ohio Facilitation Center
The Ohio Department of Education
Division of Inservice Education
65 South Front Street, Room 1013
Columbus, Ohio 43215
(614) 466-2979

OKLAHOMA

Ms. Deborah Murphy
Oklahoma Facilitator Center
101 West Broadway
Cushing, Oklahoma 74023
(918) 225-4711

OREGON

Dr. Ralph Nelsen
Columbia Education Center
11325 S. E. Lexington
Portland, Oregon 97266
(503) 760-2346

PENNSYLVANIA

Mr. Richard Brickley
Project Director
Facilitator Project, R.I.S.E.
725 Caley Road
King of Prussia, PA 19406
(215) 265-6056

RHODE ISLAND

Ms. Faith Fogle
RI State Facilitator Center
RI Department of Education
Roger Williams Building
22 Hays Street
Providence, Rhode Island 02908
(401) 277-2617

SOUTH CAROLINA

Mr. Peter Samulski
State Facilitator
Block Grant Section
Office of Federal Programs
SC Department of Education
Columbia South Carolina 29201
(803) 734-8116

SOUTH DAKOTA

Ms. Donlynn Rice
State Facilitator
South Dakota Curriculum Center
205 W. Dakota
Pierre, South Dakota 57501
(605) 224-6708

TENNESSEE

Dr. Reginald High
TN Statewide Facilitator Project
College of Education/BERS - U of TN
Knoxville, Tennessee 37996-3504
(615) 974-1945 or 4165 or 2272

TEXAS

Dr. Judy Bramlett
Texas Facilitator Project-NDN
Education Service Center Region VI
3332 Montgomery Road
Huntsville, Texas 77340-6499
(409) 295-9161

UTAH

Dr. Lyle Wright
Utah State Facilitator Project
Utah State Office of Education
250 East 500 South
Salt Lake City, Utah 84111
(801) 533-6040

VERMONT

Mr. Howard Verman
Trinity College
Colchester Avenue
Burlington, Vermont 05401
(802) 658-7429

VIRGINIA

Ms. Judy McKnight
The Education Network of VA
3421 Surrey Lane
Falls Church, Virginia 22042
(703) 698-0487

WASHINGTON

Mr. Keith Wright
Project Director
Washington State Facilitator
15675 Ambaum Boulevard, S.W.
Seattle, Washington 98166
(206) 433-2453

WEST VIRGINIA

Ms. Cornelia Toon
WV State Facilitator
Building #6, Room B-252
State Department of Education
Charleston, West Virginia 25305
(304) 348-3579

WISCONSIN

Mr. William Ashmore
State Facilitator
Department of Public Instruction
125 South Webster
P. O. Box 7841
Madison, Wisconsin 53707
(608) 267-9179

WYOMING

Ms. Nancy Leinius
State Facilitator
WY Innovation Network System
State Department of Education
Hathaway Building - Room 236
Cheyenne, Wyoming 82002
(307) 777-6226

PUERTO RICO

Mrs. Elba Encarnacion
Puerto Rico State Facilitator
Evaluation Division, 5th Floor
Department of Education
P.O. Box 759
Hato Rey, Puerto Rico 00919
(809) 753-1645

VIRGIN ISLANDS

Dr. Lois Hassell-Habteyes
State Facilitator
44-46 Kongens Gade
Charlotte Amalie
St. Thomas, Virgin Islands
(809) 774-0100 Ext. 213

AMERICAN SAMOA

Mr. Rick Davis
NDN Facilitator
Department of Education
Pago Pago, American Samoa 96799
(684) 633-5237
(684) 633-5183
FAX (684) 633-4240

NORTHERN MARIANA ISLANDS

Mr. Bob Coldeen
Federal Program Coordinator
CNMI Public School System
P.O. Box 1370
Saipan, MP 96950
(670) 322-3194
FAX (670) 322-5096

GUAM

Ms. Ernestina Cruz
Federal Program Office
Guam Department of Education
P.O. Box DE
Agana, Guam 96910
(671) 472-8524
FAX (671) 477-4587

PRIVATE SCHOOL FACILITATOR

Dr. Charles Nunley
Private School Facilitator
Council for American Private Education
1625 Eye Street, N.W.
Suite 822
Washington, D.C. 20006
(202) 659-0177